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ABSTRACT

The paper describes an experiment in which 52 deaf children (7-19 years old) and 36 normal hearing children (7-16 years old) were given several Piagetian conservation tasks to determine if the conventional instructions are the basis for conservation failure in deaf children and to examine the order in which deaf Ss acquired various forms of conservation. Research is reviewed which suggests that deaf children behave in a cognitive manner different from their normal hearing peers. It is explained that all Ss received number, liquid, weight, and volume conservation tasks under two instructional conditions (conventionally and in a modified manner with instruction changed to make the conservation attribute clear). Results are said to have indicated no statistically significant difference between the two populations in the order of conservation acquisition under either set of instructional conditions. The facilitative effect of the attribute specific instructions in both populations is seen to suggest that conventional Piagetian conservation problems may underestimate the cognitive level of children. Findings are said to indicate that deaf children should not be viewed as psychologically unique, and that general rules in teaching should apply to the teaching of deaf students. C(L)

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CONSERVATION IN DEAF AND NORMAL-HEARING CHILDREN

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CONSERVATION IN NORMAL-HEARING AND DEAF CHILDREN

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INTRODUCTION

The aim of this research was to determine if the conventional instructions associated with Piagetian conservation tasks are the basis for conservation failure in deaf children, as well as to determine the order in which deaf children acquire various forms of conservation. This second aim is of particular interest because Piaget's theory rests on the notion that cognitive achievements are made in a fixed order. The Piagetian conservation order is called horizontal decalage. There is evidence to suggest that deaf children are not only delayed in acquiring conservation, but that they also do not acquire the forms in an order predictable from Piagetian theory (Oleron and Herren, 1961; Furth, 1964; Affolter in Piaget, 1966; Rittenhouse, 1976).

Three extra-cognitive reasons have been given to explain why young, normal-hearing children and deaf children and adolescents fail to solve the Piagetian conservation problems. McGarrigle and Donaldson (1975) argue that when the experimenter transforms one of the conservation items, this action is often-times interpreted as meaningful by the subject, and when it is, the subject fails to conserve. A second argument is that deaf children confuse the relational terms more and same (Furth, 1973). Essentially, when more or same are expressed to deaf children using sign language, their intents are misinterpreted. As Furth's argument goes, deaf children assume that when the experimenter signs more, he means which item needs more in order to make it equal to the other one, and not which has more. Like-wise when same is signed, the deaf child assumes the experimenter is referring to appearance

and not to amount. The third argument is that deaf children are predisposed to consider the wrong attribute in making their conservation judgment (Rittenhouse, 1976). For example, when the two conservation items are intitially compared, as in the conservation of liquid problem, the deaf child carefully studies the height of the liquid in the two beakers and then agrees that they are equal. As Rittenhouse's argument goes, the deaf child gets confirmation that his initial judgment is correct, liquid from one of the beakers is then poured into another one which is taller and thinner and the deaf subject is again asked to consider their quantity. Having received confirmation on his first judgment and having used height as the relevant dimension, the deaf subject makes his "conservation decision" on the basis of height and, of course, fails to conserve.

For deaf children, the Piagetian liquid-conservation problem is the one which proves to be the most difficult of the various forms (Furth, 1964; Affolter in Piaget, 1966; Rittenhouse, 1976). For Piaget, conservation of liquid is common at ages 6-8 years and emerges after conservation of number which is acquired at about 5-6 years of age. For deaf children, conservation of liquid is acquired late (at about 16-17 years of age) and is usually the last conservation form to be understood (Furth, 1973). Piaget (1966) explained Affolter's finding in this way:

> The deaf children manifest a retardation in operativity that is not overly notable and the differences of retardation are due rather to the procedures by which the problem is communicated. While there may exist a certain global retardation due to linguistic deficiency, the role of language seems to consist more in stimulating general intellectual activity and in facilitating social mobility rather than in bringing about the structures of operations (pp. 63-64).

Furth (1973) agrees that the problem is linguistic and not cognitive and also argues that liquid conservation is more problematic because of its continuous rather than discrete nature.

This small but growing body of evidence suggests that deaf children behave in a cognitive manner different from their normal-hearing peers. Two of the problems, however, with the research have been: 1) its general lack of statistical rigor and 2) the fact that broad generalizations have been made on the basis of piecing together several independent studies which have been conducted at various times over a five year period, using subjects with different characteristics and employing quite different experimental procedures. This experiment was designed to more precisely describe the rate and order of acquisition of the various conservation forms by controlling for these problems and by performing a rigorous statistical analysis of the data.

METHOD

Subjects

For this study, 52 deaf children and 36 normal-hearing children were given several Piagetian conservation problems. All deaf subjects had acquired their losses before the age of two years. They ranged in age from 7-19 years with a mean age of 13 years and the normal-hearing subjects ranged in age from 7-16 years with a mean age of 9 years, 10 months. The deaf subjects attended either the state's residential school for deaf students or day classes for deaf students and all deaf subjects were conversant in sign language. All subjects had performance IQ scores of 100 or above with a mean IQ score of 114.

Tasks and Study Design

Conservation problems of number, liquid, weight and volume were presented to all subjects in the standard Piagetian manner and in a modified manner. In the modified version, the instructions were changed in such a way so as to make the conservation attribute clear. For example, in the Piagetian conservation of weight problem, the child is first asked if 2 balls of clay weigh the same. After he agrees that they do weigh the same, he is asked to predict which one would weigh more if one ball of clay was made into the shape of a hot dog. The third step in the standard conservation problem calls for the experimenter to make the actual change and then ask the subject which clay item weighs more or do they still weigh the same. Finally, the subject is asked to justify his judgment.

In the modified version, which was called the attribute specific condition in this study, a baby scale was introduced and used at all 4 steps. The subject was allowed to initially weigh the two clay balls and the experimenter made reference to the scale whenever the weight attribute was mentioned. In addition, the relational terms more, less and same were not used as part of the conservation instructions. Instead, a large mark was made on the face of scale to indicate the point at which the arm of the scale came when each clay ball was initially weighed. In asking questions about the weight of the transformed clay item in relation to the comparison clay ball, the experimenter would ask "Do you think the arm will come above the mark, below the mark or on the mark." With each of the other conservation forms, the relevant attribute was clarified through a manipulation of the instructions.

Several comparisons of the data were made and a statistical analysis was performed on the data. Within-subject and between-subject comparisons of the affect of the attribute specific instructions on the rate and the order of acquisition of conservation were made.

Procedure

Each subject was tested individually on two successive days. Testing occurred over approximately a ten-week period. All subjects received the number, liquid, weight and volume problems under both instructional conditions (i.e., conventional and attribute specific). No subject received the same conservation form on successive trials nor did any subject receive two conservation forms in succession administered under the same instructional condition. The order of the relational terms more, less and same in the conventional condition and their equivalents in the attribute specific condition were counterbalanced.

The experimenter was a skilled user of sign language, and the method of communication generally used with the deaf subjects was simultaneous communication. This form of communication was the instructional method used in the educational environments of all the deaf subjects. There were instances during the testing when American Sign Language was used to clarify the experimenter's question or to probe the thinking of the deaf subjects. In such instances, speech was not always used simultaneously with sign.

RESULTS AND DISCUSSION

Before the results are reported, one point needs to be made. While analyses of variance were performed on the data, they produced many artificial outcomes due to a ceiling-level performance reached by many of the normal-hearing subjects. Therefore, only subjects who conserved on at least one conservation form, but not all four, were considered in this study and those subjects are referred to as "intermediate" subjects in this section. It should be noted, however, that the initial ANOVA was interpretable with respect to sex effects. Sex as a main effect was not significant. Accordingly, all reported analyses are collapsed over the sex factor.

With respect to the order of acquisition of the four conservation forms, there was not a statistically significant difference between the two populations under either set of instructional conditions. Using conventional instructions, 21 of the 23 (91%) intermediate normal-hearing subjects and 23 of the 29 (79%) intermediate deaf subjects conserved along Piagetian lines (i.e., number conservation emerging first, followed by liquid, weight and volume). This difference was not significant $\underline{X}^2 = .89$, $p < .25$ (Glass & Stanley, 1970; pp. 329-330). Using attribute specific instructions, 9 of the 14 (64%) intermediate normal-hearing subjects and 12 of the 20 (60%) intermediate deaf subjects conserved along Piagetian lines. This difference was also not significant $\underline{X}^2 = .68$ $p < .40$ (Glass & Stanley, 1970; pp.329-330). However, the effect of the attribute specific instructions on the Piagetian decalage was significant in the normal-hearing subjects $\underline{X}^2 = 4.14$, $p < .025$ and marginally significant in the deaf subjects $\underline{X}^2 = 2.16$, $p < .10$ (Glass & Stanley, 1970; pp. 329-330).

The finding of a decalage similarity between the two populations under both sets of instructions supports Piaget's thesis regarding the independence of language and cognition. However, the disrupting effect of the attribute specific instructions on Piagetian decalage appears to undermine his developmental theory.

While the attribute specific instructions had the effect on Piagetian decalage of causing developmental reversals, they also significantly facilitated conservation acquisition in both populations; although they had a significantly greater effect on conservation achievement in the deaf subjects. Of 26 intermediate normal-hearing subjects, 17 (65%) went on to conserve using the attribute specific instructions when failure had occurred using the conventional instructions. This facilitative effect was a significant one $\underline{X}^2(1) = 12.472$, $p < .001$ (Glass & Stanley, 1970; pp. 329-330). Of 36 intermediate deaf subjects 25 (70%) went on to conserve using the attribute specific instructions when failure had occurred using the conventional instructions. This effect was also significant $\underline{X}^2(1) = 19.99$, $p < .001$, one-tailed (Glass & Stanley, 1970; pp. 329-330). When the conservation performance of the normal-hearing subjects was compared to the conservation performance of the deaf subjects using attribute specific instructions, the difference was a significant one in favor of the deaf subjects $\underline{Z} = 2.62$, $p < .025$ (Glass & Stanley, 1970; pp 324-326). Of the ten intermediate normal-hearing subjects, not one who failed on some tasks but not all using the conventional instructions went on to conserve using the attribute specific instructions. However, of the twelve intermediate deaf subjects with the same conventional conservation characteristics, six went on to conserve using the attribute specific instructions. This analysis excluded all subjects who had conserved on three or all of the tasks using conventional instructions.

The facilitative effect of the attribute specific instructions in both populations suggests that conventional Piagetian conservation problems may underestimate the cognitive level of children. Their greater effect on the conservation performance of the deaf subjects suggests that the extra-cognitive features of conventional Piagetian conservation problems are more problematic for deaf children than for normal-hearing children.

Summary and Educational Implications

When the instructions of the Piagetian conservation tasks were made specific to the dimension on which the experimenter was questioning the subject, the overall effect was to facilitate conservation achievement and, simultaneously, disrupt Piagetian decalage in both normal-hearing and deaf subjects. However, the attribute specific instructions facilitated conservation significantly more in deaf subjects and disrupted Piagetian decalage slightly less. The net result was that the decalage and conservation performance differences which existed between the normal-hearing and deaf subjects in favor of the normal-hearing subjects using conventional Piagetian instructions were significantly reduced by the attribute specific instructions.

One educational implication of the decalage finding would seem to be that deaf children should not be viewed as psychologically unique. The qualitative similarity between the two populations strongly suggests that the process of cognition has an innate aspect to it which deafness does not alter. Therefore, general rules in teaching would apply to the teaching of deaf children.

The increased conservation performance in the deaf children as a function of the attribute specific instructions suggests that teachers need to be specific when communicating with school children, especially when these children are deaf. Relational terms like more, less and same may appear to be clear, but in fact may be ambiguous to children.

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